

NON-MARINE MOLLUSKS AND TWO NEW SPECIES OF *PISIDIUM* FROM THE TONGUE RIVER FORMATION (PALEOCENE), NORTH DAKOTA.

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ABSTRACT

*Fifteen taxa of Paleocene freshwater Mollusca were recovered from relatively soft carbonate sediments of the Tongue River Formation (Paleocene: Fort Union Group). The beds, exposed at two sites in southern Ward County, North Dakota, apparently accumulated in a small hard-water lake. The faunule is discussed and illustrated. Unlike the few previously described species of Pisidium from early Tertiary rocks, preservation of Pisidium wardensis and Pisidium russelli n. spp. is good enough to permit detailed description of their hinge morphology.*

INTRODUCTION

The Late Cretaceous and early Tertiary deposits in the North Dakota portion of the Williston Basin record a conformable transition from marine to brackish water to non-marine sediments. The Fort Union Group includes Paleocene rocks in North Dakota and occurs in the western half of the state and on an outlier in northeastern North Dakota. These strata in North Dakota include from base to top the Tullock, Ludlow, Cannonball, Tongue River, and Sentinel Butte Formations. All are of alluvial origin except for the Cannonball Formation which apparently accumulated in an early Tertiary relic or rejuvenation of the Cretaceous seaway that crossed the midcontinent region. The Tongue River Formation was deposited over Tullock, Ludlow, and Can-

nonball sediments by a system of streams flowing from a western source with low gradients and velocities (Royce, 1970). Tongue River sediments are mostly poorly consolidated yellowish silts and clays with lesser amounts of sand, lignite coal, and limestone. Thick units that formed in backswamp and floodplain environments characterize the formation. Thick deposits of glacial drift cover pre-Pleistocene rocks east and north of the Missouri River and bedrock outcrops are small and generally limited to the larger stream valleys, shallow road cuts, and strip mines. Royce (1970) summarizes the sedimentary history of the Tongue River and Sentinel Butte Formations.

A highly fossiliferous exposure of the Tongue River Formation (Paleocene) was brought to my attention in January, 1971, by Mr. Fred Ballentyne of

Unit	Paleocene: Tongue River Formation	Thickness (Feet)
4	Buff to light gray limestone, friable, blocky; lower half coarse grained near base, finer textured toward top; mollusks abundant in limonitic band near middle.	11.3
3	Dark gray calcareous shale, soft, strongly fissile	1.0
2	Light gray to buff limestone, blocky; moderately hard at base; moderately friable above.	6.2
1	Brown to gray lignitic clay, weakly calcareous; base not exposed.	0.3
TOTAL		18.8 ft.

Sawyer, North Dakota. Most of the fossils were collected that month. The faunule from this locality is notable for the number of taxa present and the occurrence of new species of *Pisidium*. The outcrop is located about 8 miles south of Sawyer, Ward County, North Dakota in NW¼, sec. 19, T152N, R81W. The exposure is an isolated man-made cut on the west wall of a shallow coulee at about 1800 ft. above sea level. A stratigraphic section is described below:

Bedrock is completely covered on both sides of the outcrop; however, more typical Tongue River elastic sediments are exposed at the same elevation in an abandoned strip mine about 100 yds. to the west. Carbonate sediments with similar lithology and stratigraphy are poorly exposed at the same elevation about 1 mi. to the east in SW¼, NW¼, sec. 20 of the same township, but any lateral transition of this sequence into silt-clay facies that outcrop nearby is also covered.

The stratigraphic position of these beds in the Tongue River Formation cannot be accurately fixed at present. Lemke (1960, p. 30, 33) places the Tongue River-Cannonball contact at an elevation of 1540 ft. along the Souris River 8 to 9 mi. to the northeast. Allowing for a slight northeast dip in this area, these exposures are probably 200-250 ft. above the base of the Tongue River Formation.

The deposit apparently accumulated in a shallow floodplain depression or series of depressions that held a permanent hard water lake. The lake formed over elastic and organic backswamp sediments and maintained a permanent water level long enough for diverse molluscan and ostracode assemblages to become established. *Pisidium*, small anniculids, and ostracodes suggest a lacustrine environment. Viviparids are prominent elements in the Fort Union fauna and these snails probably inhabited slower moving streams as well as standing water in backswamp areas.

## SYSTEMATIC PALEONTOLOGY

### Family Unionidae

*Plesielliptio priscus* (Meek and Hayden, 1856)

Fig. 16

*Unio priscus* Meek and Hayden, 1856, Proc. Acad. Nat. Sci. Philadelphia 8: 117.

Unionid mussels are common and generally occur with both valves connected, aligned, and closed. Preservation in place is often excellent except for fractures induced by compaction, but specimens crumble

and exfoliate during extraction even with careful field and laboratory techniques. One specimen is intact enough to show both the double looped beak sculpture of *Plesielliptio* and the proportions of *P. priscus*. Its measurements are: length 78.0 mm., height 45.0 mm., width 21 mm. Three valve fragments have the concentric looped ornamentation of *Plesielliptio* but are too incomplete for specific determination. About 30 other large fragments of exfoliated hinge areas cannot be identified to genus.

### Family Corbulidae

*Bicorbula mactriformis* (Meek and Hayden, 1856)

Fig. 15

*Corbula mactriformis* Meek and Hayden, 1856, Proc. Acad. Nat. Sci. Philadelphia 8: 117.

*Bicorbula mactriformis* is the most common bivalve encountered. The numerous specimens examined range in length from a few millimeters to a maximum of 23 mm. Outlines vary from sub-ovate to sub-trigonal with most valves appearing somewhat triangular. Sub-trigonal valves seem to have greater heights in proportion to length than do ovate specimens. The genus is inequivalved. Dentition is well preserved and all intact specimens are easily distinguished from other bivalves.

### Family Pisidiidae

Hinge tooth terminology in the following descriptions is that of Herrington (1962, p. 11) with addition of the abbreviations RV and LV for right and left valves.

#### *Pisidium wardenis* new species

Figs. 9, 10

*Description:* Shell small, inflated, outline ovate; walls moderately thick; beaks prominent, slightly to distinctly raised, sub-central toward posterior; posterior margin rounded to slightly truncate; anterior margin rounded, narrower than posterior margin; dorsal margin broadly angular at umbo, forms slight rounded angle with posterior margin, smoothly curved into anterior margin; ventral margin convex; striae fine, evenly-spaced; growth pauses shallow indentations or steps; hinge narrow; lateral teeth long, covering about four-fifths of shell length; inner anterior lateral tooth AI (RV) pointed, triangular; outer anterior lateral AII (RV) linear, narrow, near distal hinge margin; anterior lateral AIII (LV) straight, triangular, cusp distal; posterior lateral teeth PI, PIII, (RV) with short cusps; posterior lateral tooth PII (LV) toward proximal hinge margin, cusp prominent;



FIG. 1. *Lioplacodes nebrascensis producta* (White) X 1; FIG. 2. *Lioplacodes mariana* Yen X 1; FIG. 3. *Lioplacodes limnaeiformis* (Meek and Hayden), a slender specimen X 1.5; FIG. 4. *Viviparus raynoldsanus* Meek and Hayden, specimen slightly compressed into plane of illustration X 1; FIG. 5. *Campeloma nebrascensis whitei* Russell X 1; FIG. 6. *Campeloma nebrascensis* (Meek and Hayden) X 1; FIG. 7. *Viviparus peculiaris* (Meek and Hayden) X 1; FIG. 8. *Gyraulus* cf. *G. militaris* (White) X 10; FIG. 9. *Pisidium wardensis* n. sp., interior of Holotype (USNM 180367) X 10; FIG. 10. *Pisidium wardensis* n. sp., exterior of Holotype X 10; FIG. 11. *Pisidium russelli* n. sp., interior of Holotype (USNM 180370) X 10; FIG. 12. *Pisidium russelli* n. sp., exterior of Holotype X 10; FIG. 13. *Hydrobia warrenana* (Meek and Hayden) X 4; FIG. 14. *Hydrobia anthonyi* (Meek and Hayden) X 4; FIG. 15. *Bicorbula mactriformis* (Meek and Hayden), interior view X 2; FIG. 16. *Plesielliptio priscus* (Meek and Hayden) X ½.

cardinal tooth C3 (RV) distinctly curved, enlarged posteriorly; cardinal teeth C2, C4 (LV) slender, roughly parallel; C2 curved, shorter than C4; C4 slightly curved or distinctly curved on anterior half.

*Types and measurements:* Types are deposited in the United States National Museum of Natural History. Holotype (USNM 180367) length 2.0 mm., height 1.8 mm.; Paratype (USNM 180368) length 1.9 mm., height 1.8 mm.; Paratype (USNM 180369) length 1.6 mm., height 1.5 mm.

*Type locality:* About 8 mi. south of Sawyer, North Dakota, NW¼, NW¼, sec. 19, T152N, R81W. Paleocene; Tongue River Formation. Collected Jan. 1971.

*Remarks:* The 40 specimens examined vary in outline and the degree to which beaks project above the hinge line. Smaller specimens tend to appear quite inflated. *Pisidium wardensis* is distinguished from other Late Cretaceous and early Tertiary pisidid clams by its inflated ovate shell, broad and rather prominent beaks, and small size. The species is named for Ward County, North Dakota.

*Pisidium russelli* new species

Figs. 11, 12

*Description:* Shell moderately small, moderately inflated, outline ovate; beaks prominent, raised above hinge, situated about one third of shell length from posterior edge; anterior and posterior valve margins rounded; dorsal margin slightly convex, rounded posteriorly, forms rounded angle with anterior margin; ventral margin convex; striae fine, evenly spaced; hinge narrow; lateral teeth long, covering about three-fourths of shell length; anterior inner lateral tooth AI (RV) long, cusp toward distal end; anterior outer lateral AII generally parallel to AI, prominent; anterior lateral AIII (LV) on inner margin of hinge, straight, cusp rounded and distal; posterior lateral teeth PI, PIII (RV) slender, low, parallel, depression for opposing tooth long, narrow; posterior lateral tooth PII (LV) slender, low cusp rounded; cardinal tooth C3 (RV) distinctly curved, enlarged posteriorly; cardinal teeth C2, C4, (LV) parallel, very slightly curved, C2 slightly shorter than C4.

*Types and measurements:* Types are deposited in the United States National Museum of Natural History. Holotype (USNM 180370) length 2.85 mm., height 2.4 mm.; Paratype (USNM 180371) length 1.75 mm., height 1.55 mm.; Paratype (180372) length 1.8 mm., height 1.5 mm.

*Type locality:* About 8 mi. south of Sawyer, Ward

County, North Dakota, NW¼, NW¼, sec. 19, T152N, R81W. Paleocene; Tongue River Formation. Collected Jan. 1971.

*Remarks:* *Pisidium russelli* resembles *P. wardensis* in outline and hinge structure. It is distinguished from that species by its less inflated shell, slightly angular dorsal-anterior margin, more posteriorly situated beaks, and parallel cardinal teeth on the left valve. The name honors Dr. Loris S. Russell.

Family Viviparidae

*Viviparus peculiaris* (Meek and Hayden, 1856)

Fig. 7

*Paludina peculiaris* Meek and Hayden, 1856, Proc. Acad. Nat. Sci. Philadelphia 8: 122.

The species is characterized by having a thin trochiform shell, about 5½ flattened and slightly convex whorls, fine growth lines, and very indistinct spiral ridges. The body whorl is angular at its base and the aperture is ovate to sub-quadrate. Three incomplete specimens were found at this site. Two specimens measure: height 18.6 mm. (juvenile whorls missing) and 18.2 mm.; width 16.5 mm. and 13.4 mm.; aperture height 11 mm. and 10 mm.

*Viviparus planolater* Russell from the Paleocene of Alberta seems to be a junior synonym of *V. peculiaris*. The relationship of *V. peculiaris* to the similar Cretaceous species, *V. conradi* (Meek and Hayden), is uncertain, and the name *V. conradi*, has priority if the two shells are conspecific.

*Viviparus raynoldsanus* Meek and Hayden, 1861

Fig. 4

Meek and Hayden, 1861, Proc. Acad. Nat. Sci. Philadelphia 13: 446.

Large adult specimens are crushed but several body whorl fragments suggest maximum shell widths of over 25 mm. The largest intact shells have heights of about 30 mm. and widths of about 20 mm. Four of eleven specimens have somewhat flattened whorls, a rounded angle where the side and base of the body whorl meet, and whorls with slight shoulders. Such specimens have an almost turbonate appearance. Meek (1876, p. 584) mentions specimens of *V. raynoldsanus* with slightly flattened and shouldered whorls.

On the basis of crushed and fragmentary specimens of *V. peculiaris* and *V. raynoldsanus*, I incorrectly reported *V. trochiformis* (Meek and Hayden) and *V. retusus* (Meek and Hayden) from this locality in an abstract (Bickel and Hall, 1971).

*Campeloma nebrascensis* (Meek and Hayden, 1856)

Fig. 6

*Bulimus nebrascensis* Meek and Hayden, 1856, Proc. Acad. Nat. Sci. Philadelphia 8: 118.

Two specimens from this site have the convex whorls, inflated body whorl, slight shoulder, and raised spiral lines of the typical form of *C. nebrascensis*. Meek (1876, p. 586) states that on some specimens "the lower whorl shows faint traces of an obscure revolving ridge just below the suture." This characteristic occurs commonly on specimens I have seen from other localities in the Williston Basin and Delimata (1969, p. 29) notes it on material from the Little Missouri Badlands. Shoulders, when present, are less prominent than on *C. nebrascensis whitei* Russell. The two specimens measure: height 27.0 mm. and 16.6 mm.; width 18.0 mm. and 12.8 mm.; aperture height 13.3 mm. and 9.0 mm.

*Campeloma nebrascensis whitei* Russell, 1931

Fig. 5

Russell, 1931, Trans. Roy. Soc. Canada, ser. 3, 25 (sec. 4): 12, pl. 2, fig. 1.

This shell is the most common of the larger viviparids encountered with 17 fairly intact specimens being recovered. Many shells are crushed by sediment compaction and others were destroyed during collection. *Campeloma nebrascensis whitei* differs from typical *C. nebrascensis* in having a prominent shoulder at the top of the penultimate and body whorl and a broad, shallow depression or sinus just below the shoulder. Five specimens lack raised spiral ornamentation. This form occurs with typical *C. nebrascensis* and is easily distinguished from it, suggesting that *C. nebrascensis whitei* may be a distinct species.

*Lioplacodes limnaeformis* (Meek and Hayden, 1856)

Fig. 3

*Bulimus limnaeformis* Meek and Hayden, 1856, Proc. Acad. Nat. Sci. Philadelphia 8: 118.

Specimens are fairly common at the exposure and generally well preserved. Most specimens have a slightly convex spire but occasionally shells (4 of 50 specimens) have relatively straight-sided spires. Three specimens have the following measurements: height 17.0 mm., 15.5 mm., 12.2 mm.; width 7.9 mm., 7.5 mm., 5.5 mm.; aperture height 7.2 mm., 6.8 mm., 5.8 mm.

*Lioplacodes mariana* Yen, 1946

Fig. 2

Yen, 1946, Amer. Jour. Sci., 244: 44-45, pl. 1, figs. 5a-5c.

Five specimens are referred to this species which is distinguished from *L. nebrascensis* by having a slender spire, less inflated body whorl, more loosely coiled whorls, and a smaller aperture. The upper two-thirds of each whorl is slightly convex and the lower third is strongly convex where it meets the lower suture. Two specimens measure: height 27.5 mm. and 26.5 mm.; width 14.0 mm. and 12.7 mm.; aperture height 11.0 mm. and 10.0 mm.

*Lioplacodes nebrascensis producta* (White, 1883)

Fig. 1

*Campeloma producta* White, 1883, U. S. Natl. Mus. Proc., 3: 97, pl. 3, figs. 7-9.

Over 100 specimens were examined and they vary in spire height, convexity of whorls, and degree of ornamentation. The original description of *L. nebrascensis* (Meek and Hayden, 1856, p. 124) depicts the variability of this species, and Russell (1931) considers *L. nebrascensis producta* and typical *L. nebrascensis* end members in the range of variation in one species. The trinomial is used here as a form name. Many of the specimens are ornamented with fine spiral raised lines that are occasionally developed enough to make juvenile and intermediate whorls appear lightly carinate. Lightly carinate shells resemble *L. tenuicarinata* (Meek and Hayden) but lack the strongly keeled and convex whorls of that species. About one-fifth of the material has the tall, slender spire and whorl morphology of *L. mariana* but retains the fuller body whorl and larger aperture of *L. nebrascensis producta*.

## Family Planorbidae

*Gyraulus* cf. *militaris* (White, 1880)

Fig. 8

*Planorbis militaris* White, 1880, Proc. U. S. Natl. Mus. 3: 159.

Two specimens of small planorbids, both crushed along the axis of coiling, resemble *G. militaris*. The illustrated specimen shows the proportions of *G. militaris* and has the deep umbilicus of that species. Shell widths of the two specimens are 1.9 mm. and 1.8 mm.

**Family Amnicolidae***Hydrobia anthonyi* (Meek and Hayden, 1856)

Fig. 14

*Melania anthonyi* Meek and Hayden, 1856, Proc. Acad. Nat. Sci. Philadelphia 8: 124.

On large specimens, penultimate and body whorls are somewhat more convex than the immature whorls. Intermediate sized shells tend to have slightly convex whorls and well impressed sutures. Smaller specimens generally have subrounded apertures, while apertures on larger individuals tend to be more elongate. Persistent and very fine spiral striae are present on adult whorls but are absent or extremely fine on juvenile whorls. Fifty-seven specimens were examined. One large and one intermediate-sized specimen measure: height 6.3 mm., 3.4 mm.; width 3.3 mm., 1.8 mm.; aperture height 2.8 mm., 1.1 mm.

*Hydrobia warrenana* (Meek and Hayden, 1857)

Fig. 13

*Melania warrenana* Meek and Hayden, 1857, Proc. Acad. Nat. Sci. Philadelphia 9: 137.

*Hydrobia warrenana* is distinguished by its conical spire, 6 to 7 slightly convex whorls, and a body whorl that forms a rounded angle with the base. This angle tends to be sharply defined on immature shells but more rounded on large specimens. The aperture is subquadrate. Two large specimens measure: length 5.6 mm., 4.8 mm.; width 2.6 mm., 2.2 mm.; aperture height 2.0 mm., 1.7 mm. Most of the 30 specimens have lengths of less than 3.0 mm.

**Family Physidae***Physa* sp.

One fragmented and apparently immature specimen of this genus was found. The apex and aperture periphery are missing and specimen length is 7.0 mm.

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